

Table S1 Complete NOAAHMP configuration

Physical Process	Available Noah-MP Options	Option Used Here
Vegetation	<ul style="list-style-type: none"> · Prescribed LAI and shade fraction · LAI and shade fraction from dynamic carbon uptake and partitioning · Shade fraction calculated from prescribed LAI · Prescribed LAI and constant shade fraction 	Prescribed LAI and shade fraction
Stomatal resistance	<ul style="list-style-type: none"> · Ball-Berry (Ball et al., 1987) · Jarvis (Chen et al., 1996) 	Ball-Berry
Soil moisture factor for stomatal resistance	<ul style="list-style-type: none"> · Noah-type (based on soil moisture) · CLM-type (based on stomatal resistance) (Oleson et al., 2010) · SSiB-type (based on stomatal resistance) (Xue et al., 1991) 	Noah-type
Runoff & groundwater	<ul style="list-style-type: none"> · TOPMODEL with groundwater (Niu et al., 2007) · TOPMODEL with equilibrium water table (Niu et al., 2005) · Infiltration-excess surface runoff and free drainage (Schaake et al., 1996) · BATS runoff and free drainage (Yang and Dickinson, 1996) 	TOPMODEL with groundwater
Surface layer drag coefficient	<ul style="list-style-type: none"> · Monin-Obukhov · Noah-type (Chen et al., 1997) 	Monin-Obukhov
Super-cooled liquid water	<ul style="list-style-type: none"> · No iteration (Niu and Yang, 2006) · With iteration (Koren et al., 1999) 	No iteration
Frozen soil permeability	<ul style="list-style-type: none"> · Linear: Hydraulic Properties from total soil moisture (Niu and Yang, 2006) · Nonlinear: Hydraulic properties from liquid water only (Koren et al., 1999) 	Linear: Total soil moisture
Radiation transfer	<ul style="list-style-type: none"> · Two-stream w/ 3D structure · Two-stream (Niu and Yang, 2004) · Two-stream with canopy gap equal to 1-(shade fraction) 	Two-stream w/ 3D structure
Snow albedo	<ul style="list-style-type: none"> · BATS (snow age, grain size growth, impurity) (Yang et al., 1997) · CLASS (only snow age) (Verseghy, 1991) 	CLASS
Frozen/liquid partitioning	<ul style="list-style-type: none"> · Jordan (1991) · Offset threshold: $T_{air} < T_{frz} + 2.2K$ · Standard threshold: $T_{air} < T_{frz}$ 	Jordan (1991)
Bottom soil temperature	<ul style="list-style-type: none"> · Zero heat flux · Prescribed (8m) bottom temp 	Prescribed (8m) bottom temp
Soil temperature solution	<ul style="list-style-type: none"> · Semi-implicit · Full implicit 	Semi-implicit